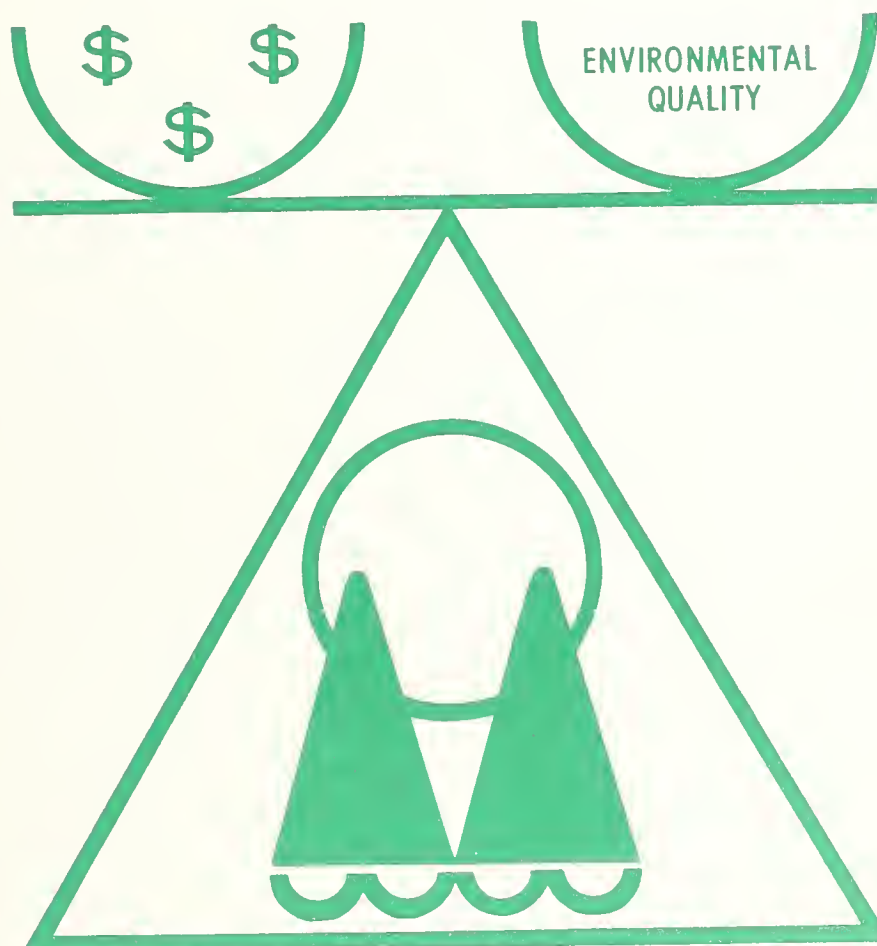


ECONOMIC IMPACT OF DISCONTINUING FARM USES OF HEPTACHLOR



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ABSTRACT

In 1971, U.S. farmers would have incurred additional costs of \$2.1 million if farm uses of the insecticide heptachlor had been discontinued. Based on estimates of 1971 acreage treated with heptachlor, this aggregate loss would have included \$1.2 million in additional costs for alternative insecticides and \$0.9 million in yield losses.

Added costs for alternative insecticides would have ranged from \$1.55 to \$1.73 an acre for corn, depending on whether corn rootworm or other soil insects were the problem. Tobacco producers would have had an added cost of \$21,300 for alternative insecticides--\$8,700 for field treatment and \$12,600 for seedbed treatment. Seed treatment costs, primarily for corn, would have increased by \$55,000

Total use of heptachlor would have decreased by 695,000 pounds if farm use had been discontinued. The increase in alternative insecticides would have ranged from 561,000 to 695,000 pounds, depending on which organophosphate or carbamate insecticide farmers had used in place of heptachlor.

Key Words: Insecticides, heptachlor, economic impact, agricultural production, corn, tobacco, seed treatment.

PREFACE

This report is in response to a request from the Pesticide Coordinator in the Office of the Secretary of Agriculture for an analysis of the economic effects of a ban on farm uses of heptachlor. The analysis considers only the aggregate effects on U.S. farmers. Localized effects or individual farm situations are not considered.

The authors express appreciation to Federal and State entomologists who provided information for or reviewed this report. Gratitude is also expressed to John H. Berry, Production Resources Branch, Farm Production Economics Division, for his contributions in the preparation of this report.

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SUMMARY

If farm use of the insecticide heptachlor were discontinued, the total cost to U.S. farmers in 1971 would have been \$2.1 million. Based on estimates of 1971 acreage treated with heptachlor, farmers would have incurred additional costs of \$1.2 million for alternative insecticides and \$0.9 million in yield losses. Most of the added costs would have been for controlling soil insects in corn.

Corn yields would have been maintained where alternative non-organochlorine insecticides were used to control corn rootworms. But where other soil insects were a problem, alternative insecticides are not as effective as heptachlor and yields would have been reduced about 2 bushels an acre. Corn farmers' costs for insecticides would have increased \$1.1 million on 669,000 acres. The added cost per acre treated would have ranged from \$1.55 to \$1.73, depending on whether corn rootworm or other soil insects were the problem. The value of yield losses would have been \$2.16 an acre on 407,000 acres of corn treated for soil insects other than corn rootworm.

Tobacco producers would have incurred an added cost of \$21,300 for alternative insecticides--\$8,700 for 3,000 acres of field treatment and \$12,600 for seedbed treatment.

Seed treatment costs, primarily for corn, would have increased \$55,000 if heptachlor use had been cancelled.

Eliminating the use of heptachlor in farm production would have had little effect on the total quantity of insecticides used. In 1971, heptachlor use would have decreased an estimated 695,000 pounds. The total increased use of alternative insecticides would have ranged from 561,000 to 695,000 pounds. Additional quantities of alternative insecticides used in corn production would have ranged from 535,000 to 669,000 pounds, depending on which organophosphate or carbamate insecticide farmers used on corn. Organophosphate insecticides used in tobacco production and for seed treatment, primarily corn, would have increased by 26,000 pounds if heptachlor registration had been cancelled.

ECONOMIC IMPACT OF DISCONTINUING FARM USES OF HEPTACHLOR

by

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INTRODUCTION

Farmers use heptachlor, an organochlorine insecticide, to control insects in crop production, primarily soil insects in corn. Heptachlor is also used to control termites in residential and commercial structures. Information on the total quantity of heptachlor used for nonfarm purposes in the United States is not available. However, 1971 pesticide use data for California show that more than 98 percent of the heptachlor used in the State was for nonagricultural purposes. 1/

This report first identifies farm uses of heptachlor. Then, we estimate the economic effects of a ban on farm use of the insecticide. To estimate the economic impact, we consider what additional costs farmers would have incurred in 1971 for alternative insecticides and what yield losses might have occurred where alternatives are not an adequate substitute for heptachlor.

The study was developed under the following general assumptions: (1) Nonagricultural uses of heptachlor were not considered, (2) economic losses on land not cropped or pastured were not considered, and (3) nonorganochlorines were the only alternative insecticides considered. This last assumption was necessary because aldrin--the best alternative to heptachlor--is also an organochlorine, and its uses are currently being reviewed by the Environmental Protection Agency (EPA). Interstate shipments of aldrin have been cancelled by EPA for a number of farm purposes, but appeals have been filed. If farm use of heptachlor is banned and aldrin can still be used to treat soil insects, there probably would be no additional costs for using aldrin. Per acre application rates and costs are about the same for heptachlor and aldrin in the control of soil insects on corn and tobacco.

Many nonorganochlorine insecticides are more toxic than heptachlor. Thus, there is a greater hazard to farm operators and workers handling these materials. Organophosphorus and carbamate

1/ Pesticide Use Report, 1971, Calif. Dept. of Agr., Sacramento, Calif.

insecticides are also less persistent than the organochlorines. 2/ In some cases, they need to be applied more frequently, resulting in adverse effects to beneficial insects. But for this study, it was assumed that one application of a nonorganochlorine insecticide replaces one application of heptachlor on crops.

FARM USES OF HEPTACHLOR

Corn producers are the major farm users of heptachlor. About 1.0 million pounds of heptachlor was used on corn in 1964 (table 1). In 1966, about 1.5 million pounds was applied to 2.0 million acres of corn, with the Corn Belt, Lake States, and Northern Plains accounting for about 99 percent of this amount.

By 1971, use of heptachlor on corn had decreased to about 634,000 pounds on 669,000 acres (table 2). The percentage of planted corn acreage treated with heptachlor decreased from 3.0 percent in 1966 to 1.0 percent in 1971. Changes in the use of heptachlor on corn in Illinois in recent years illustrate this downward trend--the percentage of planted acres treated was 11.3 percent in 1969, 6.3 percent in 1970, and 4.4 percent in 1971. 3/

The rather extensive use of heptachlor on corn in the mid-1960's was in response to the spread of corn rootworms throughout the Corn Belt. Large infestations of corn rootworms developed in the western Corn Belt around 1960, and by 1965-66, the problem was severe in Illinois. In the western Corn Belt and northern Illinois, however, rootworms soon developed resistance to the organochlorine insecticides. This resistance may partially explain the decreased use of heptachlor during 1966-71. In addition, some farmers may have stopped using the insecticide on corn cut for silage because of possible residues showing up in milk. 4/

Currently, farmers are using heptachlor to control nonresistant corn rootworms and other soil insects--primarily wireworms,

2/ Performance of nonorganochlorine insecticides may be more variable from year to year than heptachlor. Although moisture is needed to activate all these materials, too much rainfall can move the nonorganochlorines down too deep into the soil, rendering them ineffective and making additional treatments necessary. The frequency of this occurrence is not known.

3/ Data for 1969 and 1970 were obtained from Pesticide Use by Illinois Farmers, 1970, Ill. Coop. Crop Rptg. Serv., Ill. Dept. of Agr. and U.S. Dept. of Agr., May 1971.

4/ Based on discussions with entomologists in Illinois, Nebraska, and Ohio.

Table 1.--Farm use of heptachlor, 1964 and 1966

Type of use	Quantity used ^{1/}		Acreage treated in 1966	Percentage of planted acres treated in 1966
	1964	1966		
	--- 1,000 pounds ---		1,000 acres	Percent
Crops:				
Corn.....	1,099	<u>2/</u> 1,539	2,026	3.1
Tobacco.....	24	7	3	.3
Other field crops.....	<u>3/</u> 175	<u>4/</u>	4	<u>5/</u>
Alfalfa.....	<u>6/</u>	3	12	<u>5/</u>
Other hay and pasture...	<u>6/</u>	18	48	<u>5/</u>
Vegetables.....	<u>7/</u>	1	6	.2
Citrus.....	---	<u>4/</u>	2	.2
Other fruit and nuts....	---	<u>4/</u>	2	.1
All crops.....	1,298	<u>2/</u> 1,570	2,103	
Livestock and livestock buildings.....	---	3		
Other uses ^{8/}	4	20		
Total.....	1,302	<u>2/</u> 1,593		

^{1/} Active ingredient.

^{2/} Revised estimate since data were published.

^{3/} Primarily alfalfa, other hay, and pasture.

^{4/} Less than 500 pounds used.

^{5/} Less than 0.05 percent.

^{6/} Included in other field crops.

^{7/} When less than 10,000 acres were treated, the quantity used was not reported.

^{8/} Includes use on seedbeds, storage buildings, transplants, seeds, and other farm uses. Does not include use around homes, gardens, and lawns or on shrubbery and shade trees.

Source: Theodore Eichers and others, Quantities of Pesticides Used by Farmers in 1964, U.S. Dept. of Agr., Econ. Res. Serv., Agr. Econ. Rpt. 131, Jan. 1968; and Quantities of Pesticides Used by Farmers in 1966, U.S. Dept. of Agr., Econ. Res. Serv., Agr. Econ. Rpt. 179, Apr. 1970.

Table 2.--Corn acreage treated with heptachlor and quantities used, 1971 1/

State	Acres planted <u>2/</u>	Acres treated	Quantity used	Percentage of planted acres treated
	<u>1,000 acres</u>	<u>1,000 acres</u>	<u>1,000 pounds</u>	<u>Percent</u>
Indiana.....	5,679	63	63	1.1
Illinois.....	10,470	461	424	4.4
Minnesota.....	6,572	33	20	.5
Missouri.....	3,332	43	86	1.3
Colorado.....	719	42	27	5.9
14 other States <u>3/</u>	40,695	---	---	---
All other States <u>4/</u> ...	6,630	27	14	.4
United States.....	74,097	669	634	.9

1/ Based on data in Pesticide Use--1971 Objective Corn Yield Survey, U.S. Dept. of Agr. Econ. Res. Serv., Farm Prod. Econ. Div., unpublished. Nineteen States growing 91 percent of the corn in the United States in 1971 were included in the survey.

2/ Based on Crop Production, 1971 Annual Summary, U.S. Dept. of Agr., Stat. Rptg. Serv., CrPr 2-1(72), Jan. 1972.

3/ Other States included in the 1971 Objective Corn Yield Survey were Delaware, Georgia, Iowa, Kansas, Kentucky, Maryland, Michigan, Nebraska, North Carolina, Ohio, Pennsylvania, South Dakota, Virginia, and Wisconsin.

4/ For States not included in the 1971 Objective Corn Yield Survey, data for acreage treated and quantity used are based on information in 1966 Pesticide and General Farm Survey, U.S. Dept. of Agr., Econ. Res. Serv.

cutworms, white grubs, and sod webworms in southern Illinois and the eastern Corn Belt. In 1971, it was recommended for control of soil insects other than corn rootworm in the major corn producing States except Illinois. 5/

Heptachlor is also used to control soil insects, primarily wireworms, in tobacco. About 24,000 pounds of heptachlor was used on tobacco in 1964. In 1966, such use had decreased to about 7,000 pounds applied to 3,000 acres (table 1).

In 1964, about 175,000 pounds of heptachlor was used on other field crops, primarily alfalfa, other hay and forage, and pasture. By 1966, use on these crops had decreased to about 21,000 pounds. It was used primarily in the Southeast, Delta States, and Mountain regions. Heptachlor was used on hay crops to control alfalfa weevil and grasshoppers. The registration for use on alfalfa, other hay and forage, and pasture was cancelled in the mid-1960's. 6/

In the Northeast and Delta States in 1966, about 6,000 acres of vegetables were treated with 1,000 pounds of heptachlor. Small amounts were used on citrus in the Southern Plains and on other fruits and nuts in the Pacific region. These treatments were frequently spot treatments and were generally to control soil insects and ants. Heptachlor is no longer recommended for use on vegetables in those areas where it was reported used in 1966. It is recommended for spot treatment of ants on citrus in Texas. It was not registered for use in the production of most fruits and nuts in 1971. 7/

In addition to the use of heptachlor on crops, 3,000 pounds was used on livestock and livestock buildings in 1966. Currently, it is not registered for such use. 8/ Other farm uses of heptachlor amounted to 20,000 pounds in 1966. About 11,000 pounds of this was for seed treatment and 9,000 pounds for tobacco beds.

ECONOMIC IMPACT OF DISCONTINUING FARM USES OF HEPTACHLOR

In this analysis, it is assumed that cancelling farm uses of heptachlor would primarily affect producers of corn and tobacco in field crop production and in seed and seedbed treatment.

5/ Based on 1971 insect control recommendations for Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, and Ohio.

6/ Based on discussions with William Phillips, Pesticide Regulation Division, Environmental Protection Agency.

7/ Summary of Registered Agricultural Pesticide Chemical Uses, Volume III, 3rd ed., amended, U.S. Dept. of Agr., Agr. Res. Serv., Oct. 1968.

8/ Ibid.

Heptachlor is no longer registered for use on hay crops, pasture, and most fruits and nuts. It is registered for use on vegetables and citrus as a preplant soil application. It is also registered for vegetables as a root dip. However, the effect of cancelling heptachlor is not analyzed for vegetables or citrus because 1966 pesticide use data indicate that it was probably used on these crops only for spot treatments of soil insects. Thus, a few individual producers might be affected, but the total economic impact would be small.

Cancelling farm use of heptachlor would affect farmers in two ways. They would have (1) higher costs for substitute insect control and (2) yield losses where substitute insecticides are less effective than heptachlor.

Additional Costs and Losses on Corn

For control of corn rootworm, it was assumed that the nonorganochlorine insecticide substitutes would be just as effective as heptachlor, and that no yield losses would have occurred with their use. However, the substitute insecticides would have cost more than heptachlor.

For control of other soil insects in corn production, alternative insecticides are only partial substitutes for heptachlor. Hence, farmers would have had yield losses in addition to the higher costs for substitute insecticides.

Of the 669,000 acres of corn treated with heptachlor in 1971, it is estimated that 262,000 acres were treated for corn rootworm only and 407,000 acres were treated for other soil insects (table 3). The total added cost to corn producers for replacing heptachlor with nonorganochlorine insecticides would have been about \$2.0 million (table 4). For control of corn rootworm only, the cost would have been \$0.4 million. The 1971 per acre cost of alternative insecticides for corn rootworm control would have been \$2.95, more than double the \$1.40 per acre cost of heptachlor.

For other soil insect control, the total cost to replace heptachlor would have been \$1.6 million--\$0.7 million for alternative insecticides and \$0.9 million in yield losses. The cost per acre for alternative insecticides would have more than doubled, increasing from \$1.40 for heptachlor to \$3.13 for alternative insecticides. For controlling soil insects other than corn rootworm, the total additional per acre cost for replacing heptachlor on 407,000 acres treated in 1971 would have been \$3.89 per acre--\$1.73 for alternative insecticides and \$2.16 in yield losses.

Table 3.--Corn acreage treated with heptachlor for rootworm and other soil insect control, 1971 1/

State	Acreage treated with heptachlor for-- <u>2/</u>		
	Rootworm control only	Other soil insect control <u>3/</u>	All soil insect control
	<u>1,000 acres</u>		
Indiana.....	44	19	63
Illinois.....	184	277	461
Minnesota.....	---	33	33
Missouri.....	---	43	43
Colorado.....	21	21	42
14 other States <u>4/</u>	---	---	---
All other States <u>5/</u> ...	13	14	27
United States.....	262	407	669

1/ Based on data from Pesticide Use--1971 Objective Corn Yield Survey, U.S. Dept. of Agr., Econ. Res. Serv., Farm Prod. Econ. Div., unpublished. Nineteen States growing 91 percent of the corn in the United States in 1971 were included in the survey.

2/ The distribution of heptachlor use between rootworm control only and other soil insect control is based on an administrative report prepared by John H. Berry, Robert P. Jenkins, Theodore R. Eichers, and Austin S. Fox, "Economic Impact of Discontinuing Farm Uses of Aldrin and Dieldrin," U.S. Dept. of Agr., Econ. Res. Serv., Farm Prod. Econ. Div., Feb. 1972.

3/ Includes wireworms, white grubs, cutworms, seed corn beetles, seed corn maggots, and webworms.

4/ Other States included in the 1971 Objective Corn Yield Survey were Delaware, Georgia, Iowa, Kansas, Kentucky, Maryland, Michigan, Nebraska, North Carolina, Ohio, Pennsylvania, South Dakota, Virginia, and Wisconsin.

5/ For States not included in the 1971 Objective Corn Yield Survey, data are based on information in 1966 Pesticide and General Farm Survey, U.S. Dept. of Agr. Econ. Res. Serv.

Table 4. --Additional material costs and value of yield losses if alternative insecticides instead of heptachlor had been used on corn and tobacco, 1971

Item	Cost per acre 1/		Added cost of alternative insecticide or value of yield losses per acre 2/	Estimated acres treated with heptachlor 3/	Total added costs and value of production losses 4/
	heptachlor treatment	Alternative insecticide treatment			
----- Dollars ----- 1,000 acres 1,000 dollars					
Corn					
Cost of alternative insecticide--					
Rootworms.....	1.40	2.95	1.55	262	406.1
Other soil insects.....	1.40	3.13	1.73	407	704.1
Total.....	---	---	---	669	1,110.2
Value of production losses--					
Rootworms.....	---	---	---	---	---
Other soil insects.....	---	---	5/2.16	407	879.1
Total cost and value of losses--					
Rootworms.....	---	---	1.55	262	406.1
Other soil insects.....	---	---	3.89	407	1,583.2
Total.....	---	---	---	669	1,989.3
Tobacco:					
Cost of alternative insecticide..	2.80	5.70	2.90	3	8.7
Total corn and tobacco.....	---	---	---	672	1,998.0

1/ Derivation of these estimates is shown in app. table 3.
2/ Cost of alternative insecticide minus the cost of heptachlor. Costs of application did not change.
3/ Corn acreages are from table 3 and tobacco acreages are from table 1.
4/ Added cost of alternative insecticide or value of yield losses per acre times the estimated acres treated with heptachlor in 1971.
5/ Estimated loss of 2 bushels an acre times the 1971 corn price of \$1.08 a bushel. The loss of 2 bushels an acre when using an alternative insecticide treatment of heptachlor to control soil insects other than corn rootworm is assumed the same as losses that would occur if farm use of aldrin were discontinued. The estimate is based on data in an administrative report prepared by John H. Berry and others, "Economic Impact of Discontinuing Farm Uses of Aldrin and Dieldrin," Econ. Res. Serv., Farm Prod. Econ. Div.

Additional Costs on Tobacco

It was assumed that the alternative nonorganochlorine insecticide used to control soil insects on tobacco would have been as effective as heptachlor. Hence, no yield losses would have occurred in tobacco production. It is estimated that about 3,000 acres of tobacco were treated with heptachlor in 1971 (table 4).

The added cost to tobacco producers for replacing heptachlor with a nonorganochlorine insecticide in 1971 would have been \$2.90 per acre treated for a total of about \$8,700.

Additional Costs for Other Uses

The added cost for replacing heptachlor with alternative insecticides for other uses would have been \$67,600--\$12,600 for tobacco seedbeds and \$55,000 for seed treatments by farmers (table 5). Additional costs for commercially treated seed were not estimated.

Total Additional Costs and Losses

The total added cost to U.S. farmers for replacing heptachlor with nonorganochlorine insecticides in 1971 would have been \$2.1 million (tables 4 and 5)--\$1.1 million for alternative insecticides used on corn and tobacco; \$0.9 million in corn yield losses; and \$67,600 for alternative insecticides used on tobacco seedbeds and for seed treatment by farmers, primarily for treatment of corn.

Eliminating the use of heptachlor in farm production would have little effect on the total quantity of insecticides used. The quantity of heptachlor used in 1971 would have been reduced by an estimated 695,000 pounds--669,000 pounds on corn, 15,000 pounds in tobacco production, and 11,000 pounds for seed treatment. Total additional use of alternative insecticides would have been between 561,000 and 695,000 pounds. The amount of alternative insecticides used in corn production would have ranged from 535,000 to 669,000 pounds, depending on whether farmers used Bux, carbofuran, Dyfonate, or phorate to control corn rootworms and other soil insects. Diazinon use in tobacco production and for seed treatment would have increased by 15,000 pounds and 11,000 pounds, respectively, if farm use of heptachlor had been cancelled in 1971.

Table 5.--Estimated costs of alternative insecticide use instead of heptachlor on tobacco seedbeds and for seed treatment of corn, sorghum, and small grains, 1971 1/

Item	Heptachlor			Diazinon			Added cost for alternative insecticide
	Quantity of active ingredient used	Cost per pound of active ingredient	Total cost	Quantity of active ingredient used	Cost per pound of active ingredient	Total cost	
	1,000 pounds	Dollars	1,000 dollars	1,000 pounds	Dollars	1,000 dollars	1,000 dollars
Tobacco seedbeds.....	9.0	1.40	12.6	9.0	2.80	25.2	12.6
Seed treatments.....	11.0	6.40	70.4	11.0	11.40	125.4	55.0
Total.....	---	---	---	---	---	---	67.6

1/ It was assumed that diazinon would substitute for heptachlor in a 1:1 ratio for insect control in seedbeds and seed treatments. Based on discussions with Robert Mullett, Extension Entomologist, Univ. of Tenn., Knoxville, Tennessee and insect control recommendations for selected States. The higher prices for heptachlor and diazinon used in seed treatment are due to limited market for these formulations.

Appendix table 2.--Acreage of selected crops treated with heptachlor, by region, United States, 1966

Crop	Acreage treated with heptachlor in--									
	North- east	Lake States	Corn Belt	Northern Plains	Appa- lachia	South- east	Delta States	Other regions	All regions	
										1,000 acres
Corn.....	15	150	1,718	131	2/	---	11	1	2,026	
Tobacco.....	---	2/	---	---	3	---	---	---	3	
Other field crops.....	---	---	---	4	---	---	---	---	4	
Alfalfa.....	---	---	---	---	---	---	---	12	12	
Other hay and forage.....	---	---	---	---	---	14	4	---	18	
Pasture.....	---	---	---	---	---	---	28	2	30	
Vegetables.....	6	---	---	---	---	---	2/	---	6	
Citrus.....	---	---	---	---	---	---	---	2	2	
Other fruits and nuts.....	---	---	---	---	---	---	---	2	2	
All crops.....	21	150	1,718	135	3	14	43	19	2,103	

1/ Includes Southern Plains, Mountain, and Pacific regions.

2/ Less than 500 acres.

Source: 1966 Pesticide and General Farm Survey, U.S. Dept. of Agr., Econ. Res. Serv.

Appendix table 3.--Costs of using heptachlor and alternative insecticides on corn and tobacco, United States, 1971

Type of insect control	Heptachlor			Alternative insecticides		
	Quantity of active ingredient applied	Cost per pound of active ingredient	Cost per acre	Quantity of active ingredient applied	Cost per pound of active ingredient	Cost per acre
	per acre 1/			per acre 3/		
	Pounds	Dollars	Dollars	Pounds	Dollars	Dollars
Corn:						
Rootworm control only.....	1.0	1.40	1.40	Bux Carbofuran Phorate	0.8 .8 1.0	3.04 3.20 2.60
				Average cost		2.95
Other soil insect control....	1.0	1.40	1.40	Carbofuran Dyfonate Phorate	0.8 1.0 1.0	3.00 3.60 2.60
				Average cost		3.13
Tobacco:						
Soil insect control.....	2.0	1.40	2.80	Diazinon	2.0	5.70

1/ Information for corn is based on data from Pesticide Use--1971 Objective Corn Yield Survey, U.S. Dept. of Agr., Econ. Res. Serv., Farm Prod. Econ. Div., unpublished. The rate per acre is for a banded application. Preliminary results from the survey indicate that 85 percent of the farmers using heptachlor applied it in a band over the row. Data for tobacco are for a broadcast treatment recommended in selected States.

2/ If heptachlor use in corn production is cancelled, there are several insecticides that might be used to control corn rootworm and other soil insects. The list of alternative insecticides is based on (1) insect control recommendations in several States and (2) information on the most frequently used insecticides in those States where heptachlor was reported used in 1971. Data for the latter source are from preliminary results of the Pesticide Use--1971 Objective Corn Yield Survey. Entomologists in selected States indicate that if heptachlor use on tobacco is cancelled, diazinon would probably be the most frequently used alternative.

3/ The rate per acre is for a banded application on corn and for a broadcast application on tobacco. Data based on insect control recommendations in several States.

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